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Gørtz, Mette

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Centre for Applied Microeconometrics

Department of Economics
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Mette Gørtz

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Heterogeneity in Preferences and Productivity – Implications for Retirement

Mette Gørtz*

Abstract

This paper discusses the determinants of the retirement decision and the implications of retirement on economic well-being. The main contribution of the paper is to formulate the role of individual heterogeneity explicitly. We argue that individual heterogeneity in 1) productivity of market work versus housework, 2) preferences for leisure compared to consumption, and 3) marginal utility of wealth, is correlated with the retirement decision. Based on US consumption and time use data for 2001 and 2003 from the Consumptions and Activities Mail Survey (CAMS), we study the patterns of individual choices of expenditure, household production and leisure for people in and around retirement. The unobserved individual heterogeneity factor is isolated by comparing cross-sectional evidence and panel data estimates of the effects of retirement on consumption and time allocation. Based on cross-section data, we can identify a difference in consumption due to retirement status, but when the panel nature of the data is exploited, the effect of retirement on consumption is small and insignificant. Moreover, the analyses point at a large positive effect of retirement on household production. Our results therefore contribute to the discussion of the so-called retirement-consumption puzzle. Many analyses of the retirement-consumption drop assume that the retirement decision is exogenous. However, the individual decision on when to retire may depend on expected changes in consumption and time allocation. This suggests that the retirement decision is endogenous. To test this, we apply an instrumental variables method in the treatment effects tradition.

Keywords: Retirement, consumption, household production, heterogeneity
JEL classification: C23, D91, J14

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*CAM, University of Copenhagen, and AKF, Institute of Local Government Studies, Denmark.
E-mail: mette.gortz@econ.ku.dk or meg@akf.dk

1 Introduction

Trends in consumption and well-being for the elderly have attracted a great deal of attention in recent years. A vast empirical literature has identified a fall in expenditure around retirement which may seem difficult to explain in the context of the standard lifecycle model which – in its simplest form – implies consumption smoothing. This phenomenon is often referred to as the so-called “retirement-consumption puzzle”. However, while simple life cycle models may predict that *consumption* should be smoothed across periods of predictably high and low income, it is in fact the *marginal utility of consumption* that is smoothed across time periods.

Previous studies of the consumption drop offer various explanations. First, it is argued that retirement leads to a substitution from consumption bought in the market to consumption with a higher content of household production, thus retaining the same level of consumption in a broader sense. A second argument is that retirement is followed by a substitution of consumption for leisure, thereby retaining the same level of well-being. A third explanation attributes the reduction in expenditure to a reduction in consumption items related to working life, i.e. transport, eating out (e.g. lunch), work clothing etc. A fourth interpretation is that preferences change over the life cycle. And a fifth explanation focuses on the idea that if retirement is caused by an unexpected event such as job loss or disability, the observed consumption fall is not in conflict with the life-cycle model of consumption. In the following, we refer the main points of the existing literature which is centered around these five arguments.

Hamermesh (1984) tries to identify what he refers to as the “missing link” in the life cycle model. He concludes that the drop in consumption can be rationalized by a combination of a bequest motive, uncertainty about length of lifetime, coupled with a rate of time preference which exceeds the real rate of interest. Hamermesh (1984) argues that individuals may simply have preferences for consumption earlier in life, partly due to expectations about health.

This idea is also discussed in Banks, Blundell and Tanner (1998) who use a “pseudo-panel” based on 25 successive years of data from the British Family Expenditure Survey. After controlling for changes in mortality risk and labor-market-related costs there is still an unexplained gap left between actual and predicted consumption growth around the age of retirement. This leads them to conclude that there may be unanticipated shocks occurring around the time of retirement. Banks, Blundell and Tanner argue that the systematic arrival of unexpected adverse information is the only way to fully reconcile the fall in consumption.

Haider and Stevens (2004) use subjective retirement expectations (the expected year of retirement prior to actual retirement) as an instrument for retirement and thereby isolate the element of "surprise" in retirement.[1] By instrumenting retirement, the estimated consumption drop is reduced substantially.

Ameriks, Caplan and Leahy (2002) find that many working households do expect a considerable fall in consumption when they retire. After retirement, some households experience that the fall in consumption is smaller than their ex ante expectations. Ameriks, Caplan and Leahy attribute part of this divergence to unexpected stock market appreciation that may create surprises in a positive or negative direction to retiring households.

A number of contributions focus on the possibility of substituting household production for consumption at retirement, cf. Aguiar and Hurst (2004), Hurd and Rohwedder (2003), and Browning and Kolodziejczyk (2005). Aguiar and Hurst (2004) compare cross-sectional information from detailed food diaries with data on food expenditure for US households. They show that even though food expenditure declines at retirement, neither the quantity nor the quality of food consumption is lower for retired people. They underline that it is not clear whether this measure of food intake captures the utility of food consumption.

Hurd and Rohwedder (2003) use the Consumption and Activities Mail Survey (CAMS) 2001, which is part of the Health and Retirement Study (HRS) to show that a substantial proportion of households expect their expenditures to decrease upon retirement. Based on the difference between people's anticipated changes in consumption prior to retirement and their realized changes in consumption, they conclude that in general people expect a consumption drop after retirement which is larger than their realized consumption drop. In a follow-up study by Hurd and Rohwedder (2005), they use two waves of CAMS, 2001 and 2003, to examine the changes in consumption and time use over the period. They find no evidence of a consumption drop.

Browning and Kolodziejczyk (2005) consider a model where consumption and leisure are non-separable and retirement is endogenous. They argue that non-separabilities are due to 1) fixed costs of going to work, and 2) household production. They show that unobserved heterogeneity related to these non-separabilities lead to biases in the OLS estimates of the structural parameters.

Miniaci, Monfardini and Weber (2003) use synthetic cohorts in Italy and find a decline in spending at retirement. They show that Italian households who retired in the sample period had reasonable information about their pension income and argue that forward looking consumers would only choose to reduce expenditure because of their increased leisure after retirement. They find evidence that taking leisure into account markedly reduces the drop in consumption at retirement.

[1] Haider and Stevens (2004) quote Leon Trotsky (1879-1940) saying: "Old age is the most unexpected of all things that happen to a man".

Bernheim, Skinner and Weinberg (2001) find a discontinuity in consumption at retirement which is negatively correlated with retirement savings and income replacement rates. However, they find no evidence for explanations suggesting that this discontinuity should be related to differences in relative tastes for leisure, home production or work-related expenses. Bernheim, Skinner and Weinberg (2001) conclude that their results are difficult to interpret in the context of the life-cycle model and that people tend to use simple rules of thumb instead of rationally planning their retirement saving as the life-cycle model implies.

Smith (2004) uses the British Household Panel Study (BHPS) to investigate the drop in consumption of food at home and well-being.[2] She distinguishes between different groups of retired people wrt. their retirement being voluntary or involuntary (due to health or employment shocks). The idea is that when retirement is voluntary, people are assumed not to experience a negative wealth shock at retirement, while people who retire involuntarily will be more likely to experience negative wealth shocks.

Christensen (2005) uses Spanish panel data to study the effects of retirement. She finds no income fall for retiring households in the Spanish data and finds no significant effect of retirement on any commodity groups except medicines.

The main contribution of this paper is to explicitly formulate the role of individual heterogeneity in 1) preferences for the output of home production versus market products, 2) productivity in household production versus in the market, and 3) the marginal utility of wealth. We argue that unobserved heterogeneity in preferences, productivity and marginal utility of wealth may be correlated with the retirement decision. Thus, individuals with a relatively high taste for goods produced at home or with a relatively high productivity in home production may be more inclined to retire earlier than individuals with relatively higher taste for and productivity in market production. And individuals with a relatively low marginal utility of wealth will be expected to retire early, ceteris paribus. If the unobserved individual heterogeneity is correlated with the retirement status, then OLS-estimates of the effect of retirement will be biased and inconsistent.

Most previous studies of the consumption drop have been based on cross-section data or data from pseudo panels. Smith (2004) and Christensen (2005) both used panel data, but none of these studies explicitly discussed the role of unobserved heterogeneity. Pseudo panels are constructed on the basis of observables and can not take account of unobserved heterogeneity. We use the 2001 and 2003 panel from the Consumption and Activities Mail Survey (CAMS) which has information on consumption and time use. We isolate the individual heterogeneity factor by comparing cross-sectional evidence and panel data estimates of the effects of retirement on consumption and time allocation.

[2] Well-being is measured by an index which weighs together different types of self-reported factors contributing to physical, psychological and emotional well-being.

Comparing OLS-estimates with panel data estimates, we see that the fixed effects panel data estimates are numerically smaller and significantly different than the OLS estimates, and we also find that the fixed effects estimates differ significantly from the random effects estimates. We interpret this as evidence that unobserved heterogeneity in preferences, productivity and the marginal utility of wealth is correlated with the retirement decision.

In most studies of the retirement-consumption drop, the retirement index has been viewed as an exogenous variable. Thus, it is usually assumed that the retirement decision is unaffected by the level of or anticipated changes in consumption or housework, respectively. However, we can think of several examples where people's retirement decision is linked to anticipated changes in consumption or housework. Previous studies have investigated the timing of the retirement decision, cf. Gustman and Steinmeier (1986), Rust and Pheelan (1997). In this paper, we allow for endogeneity in the retirement decision by applying a treatment effects methodology. When using predicted probabilities as an instrument in our panel data analysis of the consumption and housework model, we find somewhat larger but still insignificant effects of retirement

The paper is organized as follows. In section 2, we review the theoretical background of the dynamic life-cycle model. In section 3, we present the data. Section 4 shows some empirical evidence on consumption and time use over ages. In section 5, we develop the empirical model. Section 6 presents the results from the panel data estimations. Section 7 presents an analysis of the possible endogeneity problem in the retirement decision, and section 8 concludes.

2 Theoretical background

According to the life-cycle model of consumption and labor supply, an individual/household chooses a path of consumption and leisure where the marginal utilitiy of consumption and leisure is constant over the lifetime, cf. Browning et al. (1985). Most empirical analyses of the life-cycle model formulate utility as a function of consumption of market-produced goods and leisure. Leisure is usually defined as time spent not doing market work. This definition does not take other uses of time explicitly into account. The importance of including the value of household production in the utility function has been emphasized by Gronau (1977, 1980, 1986) in his important extension of Becker's seminal work on the allocation of time, cf. Becker (1965).

The standard life-cycle model can be extended to explicitly include home production, cf. Rupert et al. (2000). We allow for three uses of time each time period, t: market work (h_{mt}), household production (h_{nt}), and leisure (l_t). The individual/household derives utility from consuming market goods (c_{mt}), home-produced goods (c_{nt}) and leisure (l_t).

Home-produced goods are produced with the input of time spent in housework (h_{nt}).[3] Wages are assumed exogenous over the life cycle. We use a marginal-utility-of-wealth-constant labor supply function, also known as a Frisch function, cf. Blundell and MaCurdy (1999). A critical assumption in this framework is that preferences show intertemporal strong separability. The marginal utility of wealth, λ_t, serves as the sufficient statistic to capture all information from other periods necessary to solve the maximization problem of each current period. For simplicity, we assume a non-stochastic interest rate. The household optimization problem can be formulated into a dynamic programming problem. The individual/household chooses consumption of market goods, household goods and leisure according to the following value function:

$$\begin{aligned}
&V(A_t, t) = \max\{U(c_{mt}, c_{nt}, l_t) + (1+\rho)^{-1} E_t[V(A_{t+1}, t+1)]\} \\
&s.t. \\
&A_{t+1} = (1+r_{t+1})(A_t + B_t + w_t h_{mt} - c_{mt}) \\
&c_{nt} = g_t(h_{nt}) \\
&h_{mt} + h_{nt} + l_t \equiv H
\end{aligned} \tag{1}$$

A_t is the real value of assets at the beginning of period t, ρ the household's subjective discount rate, r the real rate of return earned on assets between t and t+1, w_t the after-tax wage rate, B_t is unearned non-asset income, and H the total available time per period (e.g. year/week etc.). As usual, we assume that U is convex and monotonous in its elements.

It should be emphasized that we are here looking at individuals who have a positive supply of working hours in the labour market. This implies that we focus on finding an interior solution for the choice of market work, as well as for consumption and housework. We shall relax this assumption in section 5 to treat the situation where people are retired (which implies a corner solution). Solving the consumer's problem by standard dynamic programming techniques leads to the following first-order conditions:

$$\begin{aligned}
&\frac{dU}{dc_{mt}} = \lambda_t \\
&\frac{dU}{dh_{mt}} = -\lambda_t w_t \\
&\frac{dU}{dh_{nt}} = \lambda_t w_t \\
&where\ \ \lambda_t = (1+\rho)^{-1} E_t[(1+r_{t+1})\lambda_{t+1}]
\end{aligned} \tag{2}$$

$\lambda_t = \partial V / \partial A_t$ is the marginal utility of wealth. λ_{t+1} is a random variable which is realized by the beginning of period t+1. We therefore end up with the familiar result that

[3] Unlike the model derived in Rupert et al. (2000), we abstain from the - in this context unnecessary - complication of introducing home capital in the household production function.

the individual/household chooses a level of consumption of market goods where the discounted marginal utility (discounted by the subjective discount rate) equals the marginal utility of wealth (discounted by the interest rate). Furthermore, we find that the marginal utility of time devoted to market work and housework should be numerically equal across activities. And finally, we conclude that the discounted marginal utility of housework depends on the wage rate and the marginal utility of wealth, discounted by the interest rate. The first-order conditions imply that consumption demand and the supply of market work and housework can be formulated as functions of the individual's current characteristics (including wages) and the marginal utility of wealth at t, which captures all relevant information and expectations about the other periods. The Euler equation implies a time path for λ_t of the form:

$$\begin{aligned} &\ln \lambda_t = b_t + \ln \lambda_{t-1} \\ &where\ \ b_t = -\ln\left(\frac{1+r_t}{1+\rho}\right) \end{aligned} \tag{3}$$

By repeated substitution, the marginal utility of wealth, λ_t, can be expressed by an individual fixed effect, λ_0, plus the sum of the b_j terms. The b_j's are a function of the consumer's individual discount rate, ρ, and the market interest rate, r.

$$\ln \lambda_t = \sum_{j=1}^{t} b_j + \ln \lambda_0 \tag{4}$$

If we assume that ρ and r_t are constant across consumers, the first term in λ_t will vary depending on the age of the individual or household head. In cases where the rate of time preference, ρ, equals the rate of interest, then b_j=0 in all time periods, and λ is constant over time and equal to λ_0. In praxis, ρ will vary across individuals and across time and will often deviate from the rate of interest.

3 Data

Data used for this paper is from Consumption and Activities Mail Survey (CAMS) which is part of the US Health and Retirement Study (HRS). CAMS has information about time use and consumption for the elderly population in 2001 and 2003. The CAMS 2001 and 2003 data form a panel of about 3000 individuals, and information from the CAMS panel has been linked to background information from the HRS survey. The CAMS data is described in Hurd and Rohwedder (2003, 2005). Further documentation on the CAMS and HRS data can be found at the Health and Retirement Study webpage (http://hrsonline.isr.umich.edu).

The consumption part of the survey asks about recalled consumption of an extensive list of consumption items. The respondent could choose to report consumption per week, per month of per year and indicate the chosen reporting period for each consumption item. Total consumption and consumption in the main consumption groups in CAMS is comparable to consumption of the same age group in the US Consumer Expenditure Survey (CEX), cf. Hurd and Rohwedder (2005). One of the problems with expenditure information based on recall questions is that it seems to be very noisy; see Browning, Crossley and Weber (2003) for a discussion.

CAMS's time use information is based on respondents' recalled time use over the last week or month, depending on the character of the activity. Previous analyses of time use observe that so-called "stylized" time use surveys where respondents are asked about their "normal" or recalled time use have a lower variance than time use information based on a diary. On the other hand, time use diaries generally give better estimates of the means of time use. See Juster and Stafford (1991) for a discussion. The questions in the time use survey have been asked to allow for double activities. Thus, the respondents were asked to assess their time spent on different activities, irrespective of whether these activities were carried out as the single activity at the time or if the respondent performed several activities. For example, if the respondent spent one hour ironing while at the same time watching the television, the time use at both activities would be counted as one hour. The consequence of this survey method is that it is not given that the sum of all activities adds up to 24 hours a day. This is a well known picture in "stylized" time-use surveys. As the theoretical model outlined above builds on a time constraint saying that the sum of market work, housework and leisure should equate 24 hours a day, we have made the simplifying assumption that one hour spent on M activities is equal to 1/M *effective* hours devoted to each activity. In praxis, this means that we have rescaled all detailed activities to ensure that the sum of time use per person equates 24 hours a day.

Due to missing information and outliers in many consumption and time-use variables, it has been necessary to perform a thorough data cleaning. We started out with a balanced panel dataset of around 4300 observations (2179 per year) between 50 and 75 years of age. Observations with missing information or extreme outliers in both the time use part and the consumption part, and observations where the change from 2001 to 2003 seemed unrealistic (e.g. increases in consumption of more than 200 pct.), were dropped. Furthermore, we dropped observations with missing information on one of the explanatory variables. Moreover, as a panel data analysis demands information for each individual in both years, we had to drop panel observations for an individual/household if they were missing or "odd" in one of the years. The result of the data cleaning process is a somewhat smaller dataset than the original CAMS data. Consequently, we end up with a balanced panel of 1372 observations per year. A little more than half (753) of the individuals in this panel had already retired in 2001. A good 600 were not retired in

2001, and of these 158 individuals retired between 2001 and 2003, while 461 remained not retired in both years. There is a small group of people who "unretire", i.e. who were retired in 2001 but not in 2003. This is not unrealistic. Retirement is often seen as an absorbing state since it can be difficult to return to the labour market after retiring, but returning to the labour market from retirement is not uncommon.[4] But this observation could also be due to misreporting in either 2001 or 2003. In this paper, we choose to disregard individuals who "unretire".

Retirement status is generally based on people's own reporting. In the CAMS survey as well as the HRS, people were asked if they were retired or otherwise.[5] The average retirement age for the whole sample in our panel dataset is around 62 years, and the people who retired in the period 2001-2003 were around the same age on average. Figures in the appendix show the distribution of retirement ages for the whole sample and for the subset of people who retired in the period 2001-2003. The distributions appear to show similar characteristics.

4 Expenditure, time use and ageing

In the following, we document the general trends of consumption and time use in our panel dataset from 2001 and 2003. For comparison with other studies of the retirement-consumption drop, we focus on food at home and an aggregate of basic consumption items which consists of food-at-home, food-out, clothing and leisure expenditures.[6]

Data on expenditure is generally collected on a household level. The level of consumption is likely to vary depending on whether the household consists of a single person, is a married household or a household with children still living at home. As it is custom in these types of analyses, we adjust total expenditure for the number of household members. As there are obviously economies of scale related to sharing the same house and other types of consumption, it is customary to take this into account using so-called "equivalence scales", i.e. correcting consumption by a factor that takes

[4] Maestas (2004) analyzed "unretirement" transitions based on HRS data. She found that nearly one-half of retirees follow a non-traditional retirement path that involves partial retirement and/or retirement. Moreover, the unretirement rate observed at least five years after their first retirement was around ¼.

[5] It is not quite clear how homemakers and others not having participated in the labor force throughout the working ages have responded to this. Thus, there is a risk that some homemakers report themselves as not having retired although they have the age for being retired, while others report themselves of being retired, maybe because their husband is retired.

[6] Consumption in the CAMS data consists of 8 main consumption groups: housing (mortgage plus rent), utilities (energy, water and telephone), car use (petrol plus repairs/services), health related expenditure (excluding health insurance), expenditure on equipment for home and garden (but not for repairs/maintenance etc.), food at home, dining out, clothing and equipment for leisure activities (including travel expenditure) and other expenditure (gifts, contributions etc.).

economies of scale into account. We use the most simple equivalence scale, the square-root of the number of household members, to adjust for different household sizes.[7]

Figure 1 shows cross-sectional evidence from the 2001 and 2003 surveys for food at home and basic consumption. In general, we find that basic consumption is lower for the older respondents in the survey than for the younger respondents. Moreover, for almost all age categories, respondents not being retired have a higher level of basic consumption than retired people. The consumption of food at home is higher for the non-retired than for the retired, and there is a downward trend in food consumption as people age.

When looking at consumption for the retired and the non-retired groups separately, it appears that there is a negative correlation between consumption and age. However, it should be emphasized that this is cross-sectional evidence. Thus, when comparing consumption across age, we are in fact comparing consumption for different cohorts in the population. The CAMS-cohort around the age of 70, who was born in the beginning of the 1930's, has faced other possibilities and living conditions than the CAMS-cohort now around the age of 50 who was born in the 1950's. Moreover, different cohorts might have faced different options for intertemporal substitution due to long-term shifts in capital markets, interest rates etc. which might have induced them to choose different paths of consumption. Figures on total consumption and main consumption groups are shown in the appendix.

[7] Chosing the appropriate equivalence scale is a highly debated issue, cf. Atkinson and Bourguignon (2000). One of the problems with the simple equivalence scale adjustment described above is that it does not distinguish between extra household members being children or adults.

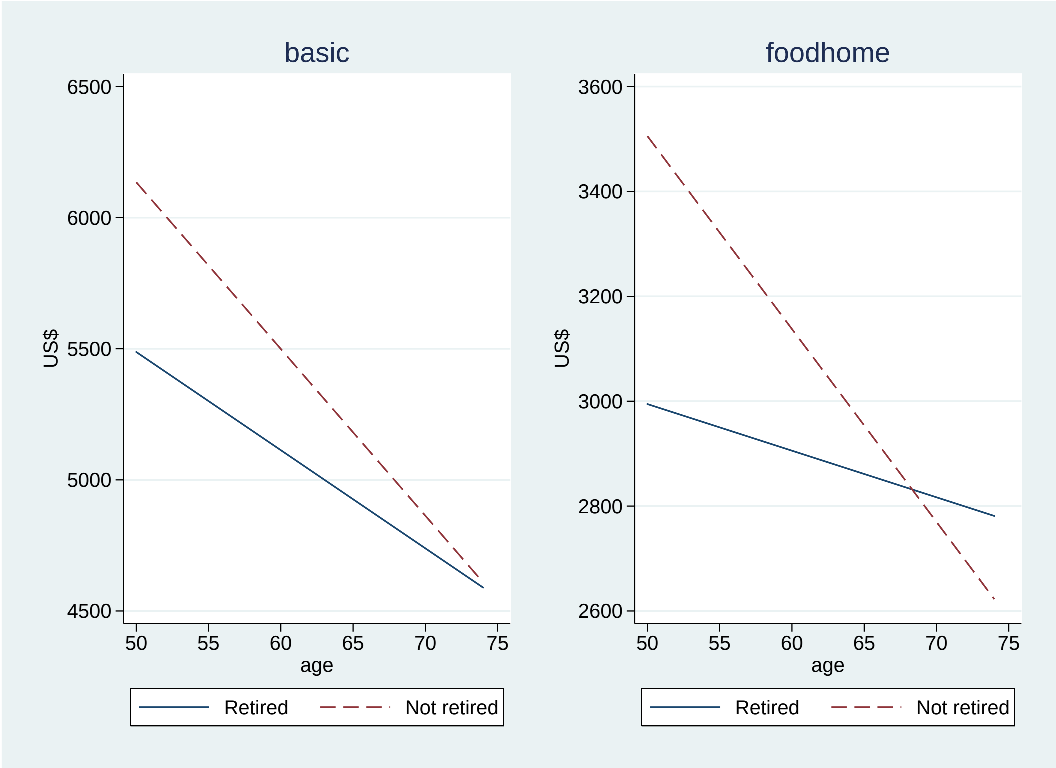

Figure 1: Expenditure through age

The respondents in the CAMS survey were also asked to state their time use on 31 activities, cf. the list of activities in the appendix. These 31 activities have been aggregated into 6 major activity groups: leisure, housework, market work, personal care, transport & communications (including computer time) and other activities (including volunteer work, helping out friends and family etc.).

Comparing time use for retired people and non-retired people, it appears that the time spent on the 6 main activities is very different between these two groups, cf. table 1. Not surprisingly, the level of market work is significantly higher for people still in the labor market (some retired people still have a low number of working hours), whereas people who have retired spend a significant number of extra hours in leisure or with housework. We also find that the time spent on personal care is somewhat higher for people who have retired, and the same is true for time spent in other activities (which is a small number of hours). On the other hand, people who have not retired spend more time traveling/commuting or communicating (using computer).

	All	Non-retired	Retired
Leisure	8.2	7.0	9.2
Personal care incl. sleep	8.1	7.4	8.6
Housework	3.1	2.5	3.5
Travel and communication	1.7	2.0	1.3
Marketwork	2.2	4.4	0.5
Other activities	0.8	0.7	0.8
No. of households	1372	619	753

Table 1: Time use in hours per day in 2001

Figure 2 shows time use over age for the retired and the non-retired group. The level of market work is at a fairly constant level over the age groups. Housework, which is at a relatively high level for the retired people, is constant for the group of retired, but slowly declines with age for the non-retired. Tables of time use over time for the other time use categories can be found in the appendix. Time spent on personal care including sleep increases with age, whereas time spent on transport & communications and other activities decreases over time for both retired and non-retired. Again, it should be noted that we are looking at cross-section data where cohort effects are present. Thus, time spent on computer use is probably affected by the fact that people in their 50’s are much more likely to have learned to use a computer than people in the 70’s. In general, these trends in time use over age confirm prior analyses, cf. Hill (1985) and Bureau of Labor Statistics (2004).

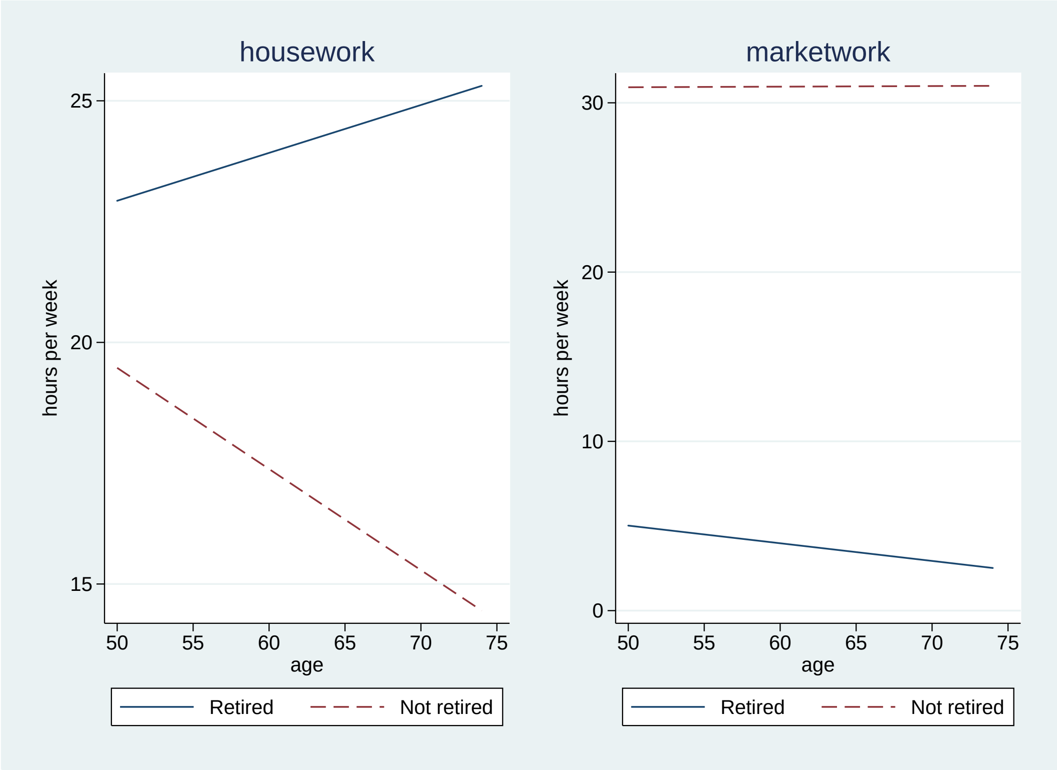

Figure 2: Time-use through age

All in all, we find that expenditure gradually decreases as people age, and that the level of consumption is lower for retired than for non-retired across all ages. Furthermore, we see that retired people have more time for household production and leisure. Thus, it seems obvious to conclude that retired people compensate for the loss of consumption of market products with a higher level of consumption of household production and a higher level of leisure.

Individual heterogeneity in preferences and productivity

The different allocations across individuals may reflect differences in productivity in the labor market and in household production, different preferences for expenditure versus leisure, different constraints in the labor and product markets, and different marginal utilities of wealth. People with a relatively high preference for market goods compared to leisure or goods produced in household production will tend to postpone retirement. Along the same lines, individuals with a relatively high productivity in household production compared to their productivity in the market may retire relatively early. Thus, people who are productive at home, good at do-it-yourself work, cooking etc. may be more interested in early retirement, giving up consumption of market goods for household production goods. On the other hand, people who are not productive in household production might hold on to their jobs in the labor market for a longer period, thereby reducing a possible consumption drop at retirement. These individual specific differences affect people's decision on when to retire, their willingness to accept a decline in consumption in order to achieve an increase in leisure, and their desire to swap hours worked in the labor market with hours worked at home.

In general, preferences are often assumed to be constant over time for the individual. This is a convenient generalization. However, the individual utility function may change over the life time as priorities and needs may change with age.[8] Moreover, productivity in market work versus in household production may change over the life. Most wage regression studies find a positive relationship between age/experience and wages/productivity, but it is not yet clear what happens to productivity when people approach and cross their retirement age. Due to depreciation of human capital, changes in work processes from technological change and gradual detriments in individual health one might expect that productivity is declining from a certain age. This hypothesis is substantiated by the fact that the unemployment risk is usually higher for people above 55 than for middle aged people. Thus, it is likely that the relative productivity of market work versus housework may change over time. For example, people may find that their market productivity degrades faster than their productivity in household production, or vice versa. This in turn might affect their retirement decision and their preferences for market goods versus household production goods.

Our theoretical model allows for individual differences in the marginal utility of wealth. We expect that people who are well off (high wealth) will have a relatively lower marginal utility of wealth than people who have less wealth. Data shows a small negative correlation between retirement age and total wealth. This implies that people who retire early have a relatively higher wealth than people who retire later in life.

[8] For example, while more than 90 percent of the respondents interviewed in HRS 2002 answered that they enjoyed going to work, it was also the case that 60 percent of the respondents who had (recently) retired reported that they were very satisfied with retirement, while another 33 percent report that they were moderately satisfied, and more than 45 percent told that their retirement years have been better than pre-retirement. Among the most important reasons for why people retire, almost 30 percent reported that they found it very important to have time to do other things; more than 35 percent wanted to spend more time with their family. Around one third of the respondents mention poor health as a very or moderately important reason for retiring, while only 6 percent said that not liking their work was a very important reason for them to retire. Moreover, people mention that the advantages to retirement is "being one's own boss", "taking it easy" and the opportunity to travel. Moreover, not being productive does not seem to worry the majority of the respondents at all, while the risk of illness/disability and not having enough income concerns around half of the respondents. A natural interpretation of these observations is that people's work life and retirement life are seen as two independent phases in life. The fact that people seem to enjoy working and later enjoy not working might reflect that preferences for consumption versus leisure change gradually as people age. Whether this change over life is truly "exogenous" or reflects that preferences are shaped by circumstances/constraints is hard to tell. One could interpret preferences as being endogenous, i.e. "you learn to love what you can get instead of getting what you love". See Hill and Juster (1985) for a discussion.

5 Empirical model

Above, we argued that there may be individual differences in preferences for consumption of market goods versus household produced goods or leisure. In order to derive an empirical model for our analysis of the joint decision of the allocation of time and consumption, we add some more structure to the general lifecycle model introduced earlier by assuming that utility is separable in its arguments, market consumption (c_{mt}), output from household production (c_{nt}), and (pure) leisure (l_t). For simplicity, we assume that utility can be expressed in the form of an add-log utility function for each individual/household, i:

$$\begin{aligned} U_{it} &= \theta_{mit} \ln c_{mit} + \theta_{nit} \ln c_{nit} + \theta_{lit} \ln l_{it} \\ \theta_{mit} &+ \theta_{nit} + \theta_{lit} \equiv 1 \end{aligned} \tag{5}$$

where θ_{jit}, $j=m,n,l$ denote individual/household i's preference/taste parameters for market goods, household produced goods and leisure, respectively, at time t. Furthermore, we assume that the productivity in household production is constant, thus ruling out economies of scale in household production. Exploiting the first-order conditions derived previously, and using the time-constraint $h_{imt} + h_{\text{int}} + l_{it} \equiv H$, we can derive two equations for the demand for consumption and household production:

$$\begin{aligned} \ln c_{mit} &= \ln \theta_{mit} - \ln \lambda_{it} \\ \ln h_{nit} &= \ln \theta_{nit} - \ln \lambda_{it} - \ln w_{it} \end{aligned} \tag{6}$$

Thus, individual i's demand for market products at time t is positively correlated with individual i's preference for market products and/or productivity in market production, and negatively correlated with i's marginal utility of wealth at t. These preferences may change over time/age. For example, people who approach the "usual" retirement age are usually well settled in their homes, costs on mortgages are decreasing or have stopped altogether etc., and this may induce them to focus more on other sources of well-being, as discussed above. In addition, preferences may depend on the composition of the household. As people age, they often cease to have financial responsibilities for supporting children. Moreover, they might have got grandchildren etc. with whom they want to spend more time. Another important source of individual heterogeneity is individual differences in productivity in the market versus productivity in the household. These individual productivities may also vary over the life cycle.

The preference factors for consumption of market goods and household production, $\ln \theta_{mit}$ and $\ln \theta_{nit}$, are specified by a set of individual specific observables as age, gender, marital status, household size, educational status etc., all captured by X_{it}. As in Zeldes (1989), we further assume that preferences depend on unobserved individual/household characteristics, time effects, and residual effects (a random term).

$$\begin{aligned}\ln\theta_{mit} &= \gamma_0 + \gamma_1 X_{it} + \phi_{mt} + \xi_{mi} + v_{mit} \\ \ln\theta_{nit} &= \alpha_0 + \alpha_1 X_{it} + \phi_{nt} + \xi_{ni} + v_{nit}\end{aligned} \tag{7}$$

The marginal utility of wealth, λ_{it}, can be expressed by a stochastic process, cf. Blundell and MaCurdy (1999):

$$\ln\lambda_t = b_t^* + \ln\lambda_{t-1} + \varepsilon_t^* = \sum_{j=1}^{t} b_j^* + \ln\lambda_0 + \sum_{j=1}^{t}\varepsilon_j^* \tag{8}$$

With this specification, the marginal utility of wealth can be captured by an individual fixed effect λ_0 plus a function of age plus a random error reflecting expectational error up to the current period.

As noted in section 2, the standard life cycle model applies to an individual with a positive labour supply, i.e. an interior solution. In the following we suggest a small adaptation to this formulation. Since an individual who is retired has zero market wage, we are in a corner solution. A convenient way to incorporate this is to drop the wage measure in the housework equation and put in dummies for retirement status, R, in both equations. We then end up with the following empirical specification of the model:

$$\begin{aligned}\ln c_{mit} &= \alpha_0 + \alpha_1 X_{it} + \alpha_2 R_{it} + \phi_{mt} + \eta_{mi} + u_{mit} \\ \ln h_{nit} &= \beta_0 + \beta_1 X_{it} + \beta_2 R_{it} + \phi_{nt} + \eta_{ni} + u_{nit}\end{aligned} \tag{9}$$

The idiosyncratic error terms, u_{mit} and u_{nit}, reflect the sum of the effects of 1) the random error from the stochastic process for λ_{it} 2) random error in the preference specification, and 3) random error in the optimization of consumption and household production, respectively. We assume that the idiosyncratic error terms are uncorrelated with retirement status R as well as with the other explanatory variables captured by X. The individual specific unobserved heterogeneity factors, η_{mi} and η_{ni}, capture 1) unobserved heterogeneity in the marginal utility of wealth, λ_{i0}, and 2) unobserved heterogeneity in preferences for market production versus household production. We control for age through X_{it}. The age parameter captures effects of age working through two channels: 1) preferences, and 2) the marginal utility of wealth.

A comparison between the estimates found by using cross-sectional data with the estimates found by exploiting the panel dimension of the data gives us an indication of the extent of unmeasured individual heterogeneity. In a cross-section estimation by e.g. OLS, the empirical model does not take explicit account of the unobserved individual factors, η_i, which are instead treated as part of a combined error term. We assume that η_i captures individual specific unobserved factors like preferences for consumption of market goods versus home produced goods, productivity in market work versus productivity in household production, and marginal utility of wealth. These characteristics may vary across otherwise comparable households. If η_i is uncorrelated with the explanatory variables in X and R, then OLS produces consistent estimates.

However, if η_i is correlated with e.g. the retirement status, R_i, the OLS-estimates of α_2 and β_2 are biased and inconsistent. This could be the case if the unobserved individual characteristics reflected by η_i tend to enhance the chance of choosing retirement at an early age. Performing OLS-regression in the equations above would then result in a biased and inconsistent estimate of the effect of R. The different sources of unobserved heterogeneity η_i result in correlation between η_i and R_i of different signs.

On the one hand, we might ex ante expect that η_i is *negatively* correlated with R_i through the following two channels:

- Relatively higher preferences for consumption of market goods rather than other sources of utility tend to keep people in labor market (low R_i).
- Higher productivity in market work rather than housework tends to postpone retirement (low R_i).

On the other hand, we may ex ante expect that η_i is *positively* correlated with R_i because:

- A person with relatively low λ_{i0} (high η_i, high wealth), will retire earlier than otherwise (high R_i).

If the correlation between η_i and R_i is negative, the OLS-estimates of the effect of retirement status R in both equations will be numerically larger than the "true" effect of retirement, α_2 and β_2. On the other hand, if the correlation between η_i and R_i is positive, then the OLS-estimates will be numerically smaller than "true" effects of retirement, α_2 and β_2. Whichever effects dominate is an empirical question.

6 Panel data estimation

Below, we compare cross-sectional evidence with longitudinal evidence from the CAMS 2001-2003 panel on consumption and time use. We perform our analysis on food-at-home and on our aggregate of basic consumption (food-at-home, food-out and clothing). In cases where we do not expect any correlation between the unobserved effect and the explanatory variables, the random effects approach is the natural choice of panel data estimator. However, as argued above, we expect the unobserved heterogeneity η_i to be correlated with retirement R_i. Moreover, unobserved heterogeneity in relative preferences and relative productivity is likely to be correlated with other individual and household characteristics, captured in X_i. This speaks in favour of using a fixed effects approach which allows correlation between the unobserved effect and the explanatory variables. The fixed effects approach does not allow the inclusion of time-constant explanatory variables in X_{it}. The problem is that time-demeaning in the context of the fixed effects approach generates collinearity between the time-constant explanatory variables and the unobserved heterogeneity effect. The time-constant explanatory variables are not identified as they are perfectly correlated with the unobserved heterogeneity. In our study, the parameter of primary interest is the coefficient to R, which changes over time. The fixed effects approach allows us to interpret the coefficient to R.[9]

	OLS		Random effects panel data estimator		Fixed effects panel data estimator	
Retired	-0.062	(-2.42)	-0.037	(-1.34)	0.054	(1.14)
Age	-0.006	(-3.01)	-0.007	(-2.93)	-0.034	(-4.37)
D partner	0.158	(6.94)	0.136	(5.07)	-0.215	(-2.76)
Education, years	0.038	(9.51)	0.042	(8.5)	-	
Wealth	0.124	(7.87)	0.086	(5.13)	-0.028	(-1.06)
Dummy d2003	-0.041	(-1.96)	-0.042	(-2.73)		
Constant	8.187	(59.45)	8.223	(49.6)	10.663	(21.8)
R^2	0.12		0.12		0.00	
N	2604		2604		2604	

Note: t-values in parentheses.

Table 2: Estimation results, log consumption of basic commodities

The OLS regressions indicate that retirement status has a significant effect on log basic expenditure in the first column. Obviously, retirement status and age are strongly correlated, but both show up significant in the OLS regression. Having a partner also has a positive effect on basic consumption. Since consumption has been corrected for equivalent household size, a positive effect from having a partner might indicate either that this correction is not adequate or that married households can exploit economies of

[9] In cases where the interest lies in the coeffients of the time-constant explanatory variables and where there is concern that the unobserved effect is correlated with some explanatory variables, it may be a problem to find an appropriate panel data estimator. Random effects will produce inconsistent estimates of all parameters. And fixed effects (or first differencing which produces equal results in a two period context) eliminates the time-constant variables. In cases when all time-constant variables are assumed to be uncorrelated with the unobserved effect while the time-varying variables are possibly correlated with the unobserved effect, a Hausman and Taylor type model may be an alternative, cf. Wooldridge (2001). The Hausman and Taylor (1981) estimator fits random-effects models in which some of the covariates are correlated with the unobserved individual-level random effect. The idea is that there is a subset of the time-invariant and time-varying explanatory variables that can be assumed a priori to be uncorrelated with the unobserved heterogeneity effects. This subset of explanatory variables can be used as instruments in defining a number of moment conditions that can be solved using a GMM approach. Applying the Hausman and Taylor estimator on our data resulted in a parameter estimate for retirement very close to the fixed effects estimate.

scale through e.g. fixed costs as housing, cars etc. and therefore have more money left for expenditure on variable consumption items. An alternative interpretation might be that having a partner may be correlated with a higher employment probability, higher income etc. because these characteristics are considered attractive elements in the marriage market. Finally, having a partner is negatively correlated with age in the age group above 50.

Moving from cross-sectional analysis to panel analysis makes the effect of retirement somewhat smaller and the effect of age larger. The random effects estimation results are shown in column 2 and the fixed effects results in column 3. In particular, in the fixed effects approach, the effect of retirement is small and insignificant. The Hausman test verified that the fixed effects estimates are significantly different from the random effects estimates and the OLS estimates, respectively. This is interpreted as evidence in favourr of the fixed effects assumption that the unobserved individual specific effects are correlated with the explanatory variables.[10]

The same regressions were performed for the consumption of food-at-home, cf. table 3. The estimates and test results for the food-at-home equation are in line with the results for basic commodities above. The smaller effect of retirement in the panel data setting is in accordance with the idea that unobserved heterogeneity in preferences/productivity in market production versus household production will lead to a (numerically) upward bias in the OLS estimates. A number of explanations could be offered for this. One obvious explanation is that the OLS-analysis only catches the cross-sectional variance in expenditure. Expenditure differences between retired and non-retired are due to the fact that different types of individuals choose different timing of retirement due to different preferences for leisure versus consumption or different productivities in housework versus market work.

[10] We should however be aware of the usual caveats when using the Hausman test. First, that strict exogeneity is maintained under the null and the alternative. Consequently, correlation between the explanatory variables and the idiosyncratic errors within and across time periods causes both fixed effects and random effects to be inconsistent. Secondly, the Hausman test is implemented assuming that the conditional variances are constant and the conditional covariances are zero when using the random effects estimator. If this is not the case, the standard Hausman test may fail.

	OLS		Random effects panel estimator		Fixed effects panel estimator	
Retired	-0.065	(-2.11)	-0.048	(-1.44)	0.073	(1.09)
Age	-0.003	(-1.24)	-0.004	(-1.36)	-0.056	(-5.22)
D partner	0.158	(5.76)	0.151	(4.85)	-0.057	(-0.53)
Education in years	0.020	(4.03)	0.021	(3.66)	-	
Wealth	0.047	(2.48)	0.039	(1.92)	-0.009	(-0.25)
Dummy for 2003	-0.091	(-3.58)	-0.092	(-4.35)	-	
Constant	7.736	(46.44)	7.771	(40.82)	11.431	(16.71)
R^2	0.04		0.04		0.04	
N	2604		2604		2604	

Note: t-values in parentheses.

Table 3: Estimation results, log consumption of food at home

An alternative explanation could be that people having retired in the time span 2001-2003 might not have adjusted their consumption levels, yet. Thus, the fact that we do not observe as large an effect of changes in retirement status in the panel data estimations might simply reflect that the consumption drop is not reflected in the 2003 data. It is difficult to reject this argument since we do not have more recent data. It would undoubtedly have been nice to have a longer panel. However, other analyses of the consumption drop seem to point to the fact that the drop is experienced very close to the retirement date and that people adjust their consumption upwards later, cf. Hurd and Rohwedder (2003) and Banks, Blundell and Tanner (1998). Banks, Blundell and Tanner (1998) find that consumption *growth* drops around retirement but returns to a somewhat higher level a couple of years after retirement. Hurd and Rohwedder (2003) compare survey information on people's expected consumption drop around retirement with their information on actual consumption change around retirement and conclude that people are more pessimistic about retirement's effects on their consumption levels than what appears to be necessary.

It could also be argued that the people who chose to retire between 2001 and 2003 did not retire following a planned retirement decision, but rather retired following an unemployment period and unsuccessful job search. This would probably imply that they had already adjusted their consumption to a lower level of income prior to retirement. Other studies find evidence of such an effect, cf. Christensen (2005) or Smith (2005). Due to the relatively small group (around 160 people) changing retirement status between 2001 and 2003 in our data set, we have not tried to subdivide this group further.

	OLS		Random effects panel estimator		Fixed effects panel estimator	
Retired	0.430	(11.92)	0.413	(10.60)	0.300	(3.84)
Age	-0.002	(-0.68)	-0.001	(-0.39)	-0.037	(-2.89)
Dummy woman	0.512	(16.44)	0.510	(14.19)	-	
Dummy partner	-0.004	(-0.11)	-0.011	(-0.31)	-0.244	(-1.91)
Education in years	-0.032	(-5.67)	-0.032	(-4.87)	-	
Wealth	0.014	(0.64)	0.007	(0.30)	-0.035	(-0.81)
Dummy 2003	-0.082	(-2.77)	-0.082	(-3.33)	-	
Constant	2.863	(14.35)	2.831	(12.43)	5.198	(6.47)
R^2	0.17		0.17		0.01	
N	2604		2604		2604	

Note: t-values in parentheses.

Table 4: Estimation results, log household production

From the estimates in table 4, columns 1-3, we find that the housework increases by around 40 pct. when retirement status changes from 0 to 1. Being a woman has a large positive and significant effect on the amount of housework, and the level of education affects housework negatively. Age as well as having a partner has a negative and significant effect on the demand for housework in the fixed effects estimates. Comparing the OLS estimates in column 1 with the panel data estimates in columns 2-3, we see that the effect of retirement status is larger for the cross-section estimates than for the panel estimates. Again, we interpret this as evidence in favour of the idea that unobserved heterogeneity in preferences for consuming the output from household production and in individual productivity in household production are correlated with the decision to retire. Therefore, the OLS estimates are upward biased and inconsistent. The Hausman test rejects the null that the fixed effects estimates are the same as the random effects and the OLS estimates. This is evidence in favour of the fixed effects assumptions that the unobserved heterogeneity is correlated with the explanatory variables. We find a correlation between the error terms in the consumption equations and the housework equation of around 0.06. This may suggest estimating the consumption and the household production equations simultaneously. We leave this challenge for future analysis.

In the following discussion of panel data versus cross-sectional evidence (OLS) we shall assume that the functional form above is correct. It is important to note that panel estimates produce precise estimates of the effect of retirement only if:

a) “Enough” people change retirement (R) status over the period.

b) The unobserved individual specific effects (η_i) really are fixed over time.

c) The change in retirement status is exogenous.

Assumption (a) is a crucial assumption as it is not possible to identify any effects of R in the panel data context if R does not change. 8 percent of the sample - around 160 people – changed status between 2001 and 2003. In a statistical context, this is not a large number of observations and may be an explanation of why the effects of changes in retirement status were insignificant in at some of the panel regressions. The CAMS survey will be updated with a 2005 wave some time in 2006. Adding a new wave will probably enhance the panel data quality and improve the reliability and statistical significance of the effects analyzed.

Assumption (b) also deserves some attention. It is highly probable that people’s preferences for consumption versus leisure change as they age. On the productivity side, people’s productivity is likely to decline with age, and this might affect their market productivity more than their productivity in household production. This is explicitly reflected in our modeling of individual preferences as a function of observables including age.

Assumption (c) – that the change in R is exogenous – can obviously be challenged. Previous studies on the retirement decision, cf. Gustman and Steinmeier (1986), Rust and Pheelan (1997) etc., suggest that people’s timing of retirement depends on a number of factors, including the level of income compensation upon retirement. Consequently, it is highly likely that people postpone retirement depending on their anticipated consumption change. The decision to retire is taken under numerous uncertainties, i.e. changes in professional and marital status, risk of illness, changes in tastes, retirement systems etc. We will investigate this issue further below.

Unobserved heterogeneity is only one type of problem. Another problem which is probably also relevant in the context of the CAMS dataset is measurement error. The CAMS data is subject to measurement error in consumption and time use, as discussed in the data section. Consumption and time use are left-hand side variables in our analysis, and under the classical errors-in-variables assumption that the measurement error is uncorrelated with the independent variables, measurement error has no effect on the statistical properties of OLS but may lead to larger standard errors, cf. Wooldridge (2002). More importantly, the indicator for retirement status may be subject to measurement error. In the data, retirement status is determined by respondents’ own information about whether they are retired. Previous analyses show that people’s perception of whether and when they have retired can vary. For example, some people who have been outside the labor force for most of their careers as homemakers will report that they are retired, others may not, perhaps depending on the retirement status of their spouse. People who are unemployed might report to have retired, and others might report that they are unemployed while they effectively are not active in job seeking anymore. And others again have effectively withdrawn from the labor force, but do not consider themselves retired and do not claim social security pensions or other pensioners benefit.

In the case of a classic measurement error of a *continuous* right-hand side variable where the error is uncorrelated with the true indicator (but correlated with the observed), we know that the estimated parameter will always underestimate the true parameter, and that the attenuation bias depends on the variance of the measurement error and the variance of the unobserved "true" indicator. In general, the attenuation bias is worse in the panel setting. In a model where the right-hand side variable in question is *binary* as it is the case with retirement, the standard assumption about the classical measurement error being uncorrelated with the true value of R no longer holds. For example, if the true value of R is 1 and the observed value is 0, the measurement error is always -1, and vice-versa, and the measurement error is then correlated with the true value of R. To conclude, there are two types of bias – selection (unobserved heterogeneity) and measurement error – which affect the parameter estimates in opposite directions. The direction of the net effect is unknown.

7 Endogeneity in the retirement decision

In the previous analysis, retirement was treated as an exogenous variable. Thus, we assumed that the retirement decision is unaffected by the level of or anticipated changes in consumption or housework, respectively. However, we can think of several examples where people's retirement decision is linked to anticipated changes in consumption or housework. For example, consider two otherwise identical people who have different expectations about their consumption drop at retirement due to e.g. unobserved differences in pension schemes. If the person who anticipates the highest drop decides to postpone retirement in order to smooth consumption, then we may underestimate the costs of retirement in the form of a consumption drop. Another example is two people with the same individual and household characteristics, but with different costs (in terms of expenses or time) of going to work. We may see that the person with the higher costs of going to work will choose to retire sooner than the person with the lower costs. Moreover, the drop in expenditures will be higher for the person with the higher costs of going to work even though this extra drop does not result in a drop in well-being.

Previous studies on the retirement decision, cf. Gustman and Steinmeier (1986) or Rust and Pheelan (1997), suggest that people's timing of retirement depends on a number of factors, including the level of income compensation upon retirement. Thus, it is very likely that people postpone retirement depending on their anticipated consumption decrease.[11] Now, the decision to retire is taken under numerous uncertainties, i.e. changes in professional and married life, risk of illness, changes in taste, retirement systems etc. We will investigate this issue further below.

With retirement status R being a binary and possibly endogenous explanatory variable, we can profit from the methodology of estimating Average Treatment Effects (ATE), cf. Wooldridge (2001). The central problem faced in the treatment effects literature is that for each individual we observe either the outcome with treatment (y_1) or the outcome without treatment, the so-called "counter-factual" (y_0), but since an individual cannot simultaneously be in both stages, we cannot observe both outcomes. If the treatment, retirement, was randomly assigned, estimation of the average treatment effect would simply be the difference between the average outcome of the treated and the average outcome of the untreated. However, for retirement (as for many other treatments) randomization is infeasible. Instead, individuals determine themselves whether they want to retire. And this decision is often related to the benefits/costs of treatment. Consequently, there is self-selection into retirement.

The parameter of interest is the difference in outcomes with and without treatment, $y_1 - y_0$. In many contexts, the main measure of interest is the average treatment effect (ATE), i.e. the expected effect of treatment on a randomly drawn person from the population:

$$ATE \equiv E(y_1 - y_0) \tag{10}$$

The treatment effects literature offers some suggestions to solve the problem of finding the counterfactual effect. The idea is that by conditioning on observables, X, we can eliminate the bias that arises from self-selection into retirement. Broadly speaking, there are two main types of treatment effects estimators. One group of estimators is based on the assumption of ignorability-of-the-treatment conditional on the covariates. In our context, this assumption implies that, conditional on observables X, retirement R and (y_0, y_1) are independent: [12]

[11] As an illustration, we performed a simple probit of non-retired citizens choice to retire. If not retired in 2001, CAMS asked what their expected change in consumption would be if they retired right now. In CAMS 2001, non-retired respondents were asked if they expected that their consumption would increase, decrease or stay the same if they should choose to retire, and by how much their consumption would change in percent. Controlling for age, gender, partner and health change, we find that people's expectations about their consumption change upon retirement is significantly correlated with their probability to retire. One possible explanation could be that people use the timing of retirement to smooth consumption over time, thus postponing retirement until the decline in consumption is not too large.

[12] The interpretation of the conditional independence assumption is that two people with the same observables X, one being retired and the other not being retired, the outcome of the retired person, had he/she not retired, is the same as the outcome for the non-retired person. Likewise, again holding X fixed, the outcome of the non-retired person, had he/she retired, is the same as the outcome for the retired person. Thus, conditional on X, we can eliminate the selection bias. The conditional independence assumption always holds if retirement is a deterministic function of X, in which case we have so-called "selection on observables".

$$(y_1, y_0) \perp R \mid X \tag{11}$$

However, people's timing of retirement may be linked to anticipated changes in consumption or housework upon retirement. Thus, people select into the treatment (retirement) based on expectations about the benefits and costs of the treatment. The instrumental variable approach is useful when we suspect failure of the ignorability-of-treatment assumption. The idea is that the instrument should predict treatment after partialing out controls. Furthermore, the instrument should be unrelated to unobserved heterogeneity.

We can predict retirement by performing an estimation of the retirement choice based on predetermined individual or household observables. In order to predict each person's retirement status in 2001 and 2003, we performed a probit with retirement status as the dependent variable and a number of characteristics known prior to these years as age in the form of age dummies, gender, years of education etc. captured in the matrix X. The probability of a person being retired takes the following form:

$$p(X) \equiv P(R = 1 \mid X) = \Phi(X\beta) \tag{12}$$

The results are presented in table 5 below. The estimation is based on pooled observations from 2001 and 2003. The pseudo-R^2 of the estimation is 0.24. On average, the probit model seems to fit the data quite well: the observed average propensity to retire and the predicted probability of retirement are both around 0.61. The dummies for age 62 and 65 confirm the peaks in retirement found in other studies. These are due to specific institutional settings in the US, especially connected to the social security system. The probit estimation verifies that non-linearities related to age are important in the identification of the timing of retirement.

The IV approach has been used in previous analyses to reduce the impact of unexpected events such as job loss or disability in the retirement decision. Some of these studies have also used non-linearities in age as instrument for retirement, recognizing that the probability of retirement is higher at certain ages when workers become eligible for government retirement benefits. Haider and Stevens (2004) point to two potential problems when choosing non-linearities in age as an instrument for retirement. First, older households generally reduce their consumption as they age, as we show in section 4. The rapid change in retirement status by age may be correlated with changes in the marginal utility of consumption at these ages. If these changes are not captured by the control variables but are correlated with the non-linearity in age, then the exclusion restriction is violated and age is an inappropriate instrument. Second, when using age as an instrument, it is implicitly assumed that the relationship between age and actual retirement is the same as the relationship between age and expected retirement. However, the fraction of workers who retire unexpectedly may vary systematically by age. Haider and Stevens (2004) show that this is not the case and conclude that age is not a valid instrument for expected retirement. Instead, they use anticipated retirement time as an instrument, as discussed in the introduction to this paper.

On the other hand, we argue that consumption is correlated with age measured as a continous variable, while age dummies do not contribute to the identification of consumption. Including age dummies in our consumption equations and household production equations above instead of age as a continous variable resulted in insignificant age dummies.

	Coefficient	t-statistic
Dummy for woman	0.029	0.49
Education in years	-0.026	-2.49
Dummy for 2003	0.115	1.99
Dummy for age 51	-0.175	-0.31
Dummy for age 52	-0.179	-0.33
Dummy for age 53	-0.278	-0.55
Dummy for age 54	0.029	0.06
Dummy for age 55	-0.189	-0.39
Dummy for age 56	0.163	0.35
Dummy for age 57	-0.009	-0.02
Dummy for age 58	0.181	0.38
Dummy for age 59	0.141	0.3
Dummy for age 60	0.590	1.26
Dummy for age 61	0.514	1.1
Dummy for age 62	1.081	2.32
Dummy for age 63	1.151	2.48
Dummy for age 64	1.256	2.68
Dummy for age 65	1.510	3.23
Dummy for age 66	1.479	3.15
Dummy for age 67	1.561	3.33
Dummy for age 68	1.694	3.6
Dummy for age 69	1.822	3.84
Dummy for age over 70	2.297	4.97
Constant	-0.528	-1.11

Note: t-values in parentheses.

Table 5: Probit estimation for retirement status

The predicted probabilities from the probit estimation are therefore used as instruments in the following. The estimations are performed using the fixed effects panel data estimator with instruments (xtivreg in Stata), cf. Wooldridge (2001). We estimate the usual equations by IV with retirement status instrumented. Instruments are 1, X_i and predicted probabilities, $\hat{p}_i$. A couple of alternative panel IV estimations were also implemented, see Wooldridge (2001) for a discussion of different procedures. One of these was to extend the above procedure to include the explanatory variables for retirement interacted with the deviation between the other explanatory variables and their respective means, i.e. $R_i * (X_i - \overline{X})$. Thus, the equations were estimated by IV with retirement status instrumented and instruments 1, Xi, $\hat{p}_i$, and $\hat{p}_i * (X_i - \overline{X})$ (predicted retirement probabilities interacted with deviations from the means of X_i. The IV procedure was also extended with normal densities $\hat{\phi}_i = \phi_i(X_i \hat{b})$ of the index function (latent variable function) in the estimation equation (and as an instrument). Finally, we ran a fixed effects regression on 1, Ri, Xi, $R_i * (X_i - \overline{X})$, $R_i * \hat{\phi}_i / \hat{\Phi}_i$, $(1 - R_i) * \hat{\phi}_i / (1 - \hat{\Phi}_i)$. This is a fixed effects version of "switching regressions" due to Heckman, see Vella and Verbeek (1999). The results for consumption of food-at-home and household production when using the first of the IV procedures above and the "switching regressions" procedure are shown in tables 6-7 below.

	Fixed effects IV		FE “Switching regressions”	
Retired (R)	-0.526	(-1.00)	-0.218	(-0.85)
Age	-0.025	(-0.82)	-0.038	(-2.23)
Dummy for partner	-0.015	(-0.13)	-0.036	(-0.28)
Years of education	-		-	
Wealth	0.006	(0.14)	0.036	(0.76)
R*dev(age)	-		0.009	(0.41)
R*dev(partner)	-		-0.031	(-0.26)
R*dev(education)	-		-0.009	(-0.40)
R*dev(wealth)	-		-0.093	(-1.44)
$R_i * \hat{\phi}_i / \hat{\Phi}_i$	-		0.365	(1.97)
$(1-R_i) * \hat{\phi}_i / (1-\hat{\Phi}_i)$	-		-0.021	(-0.13)
Dummy 2003	-		-	
Constant	9.731	(5.94)	10.282	(10.39)
N	2604		2604	

Note: t-values in parentheses.

Table 6: Consumption of food-at-home, fixed effects instrumental variable approach

Using predicted retirement as instrument in the consumption equations results in somewhat higher estimates for the effect of retirement status on consumption than the fixed effects estimations in tables 2 and 3. Since the results are insignificant regarding the effect of retirement, one should be cautious when interpreting the results. One careful interpretation could be that a prediction of retirement status solely based on predetermined household and personal characteristics obviously does not take individual or personal characteristics related to different time preference rates, risk aversion etc. into account. Thus, when we “force” people to retire based on their observed characteristics, the decline in consumption is somewhat higher than the observed decline based on realized behaviour. This suggests that people tend to smooth consumption with the timing of their retirement decision. Table 7 shows that the IV estimates for the housework equation are somewhat smaller (and insignificant) than the fixed effects estimates that we presented in table 4.

	Fixed effects IV		FE "Switching regressions"	
Retired (R)	0.441	(0.74)	0.136	(0.45)
Age	-0.044	(-1.30)	-0.035	(-1.74)
Dummy for woman	-		-	
Dummy for partner	-0.254	(-1.89)	-0.246	(-1.62)
Years of education	-		-	
Wealth	-0.039	(-0.84)	-0.056	(-0.99)
R*dev(age)	-		-0.050	(-2.04)
R*dev(partner)	-		-0.157	(-1.01)
R*dev(education)	-		-0.006	(-0.04)
R*dev(woman)	-		0.012	(0.45)
R*dev(wealth)	-		0.044	(0.57)
$R_i * \hat{\phi}_i / \hat{\Phi}_i$	-		-0.107	(-0.49)
$(1-R_i) * \hat{\phi}_i / (1-\hat{\Phi}_i)$	-		-0.187	(-0.93)
Dummy for 2003	-		-	
Constant	5.600	(3.00)	5.337	(4.59)
N	2604		2604	

Note: t-values in parentheses.

Table 7: Housework equation, fixed effects instrumental variable approach

8 Conclusion

The main purpose of this paper is to explore the role of unobserved individual heterogeneity for the effects of retirement on consumption and household production. We argue that there are three major sources of individual heterogeneity: 1) heterogeneity in preferences for consumption versus leisure and household production, 2) heterogeneity in productivity in market work versus housework, and 3) heterogeneity in the marginal utility of wealth. The unobserved individual heterogeneity is likely to be correlated with the retirement decision. Thus, people with relatively high preferences for leisure or the output from household production or with a high productivity in household production will tend to retire earlier. And individuals with a relatively low marginal utility of wealth will retire relatively early. In that case, OLS-estimates of the effects of retirement will tend to be biased and inconsistent. By exploiting the panel dimension of our data, we find that the effects of retirement on consumption and household production are numerically smaller in a panel data analysis than when analyzed with OLS. Moreover, the fixed effects estimates, which assume some sort of correlation between the unobserved heterogeneity and the explanatory variables, are significantly different from the random effects estimates, which assume no such correlation. We interpret this as evidence in favour of unobserved heterogeneity being an important factor in the retirement decision. Moreover, the direction of the bias points at unobserved heterogeneity in 1) preferences for household production and leisure versus market goods and 2) productivity in household production versus market production as affecting the retirement decision.

Most studies of the retirement-consumption drop assume that the retirement decision is exogenous. However, it seems reasonable that people consider their expected changes in consumption and time for e.g. household production when they decide when to retire. Thus, retirement may be endogenous. We address the endogeneity issue by using a treatment effects approach where predicted probabilities of retirement are used as instruments for retirement. The IV estimates when applying this method are numerically higher than the results under the exogeneity assumption and insignificant.

Appendix

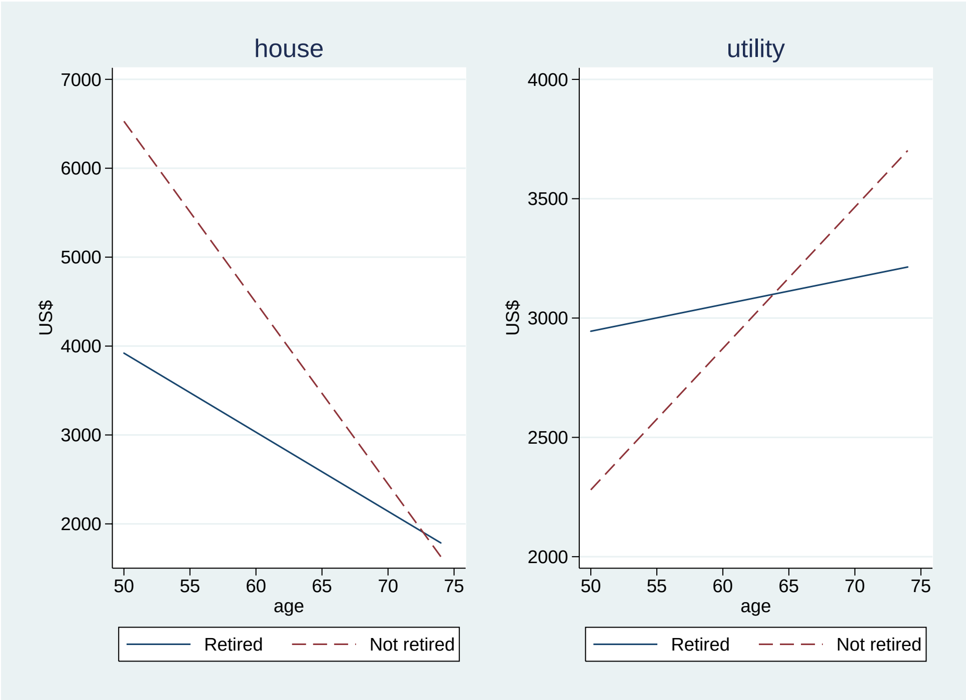

Figure A1: Expenditure on housing and utilities

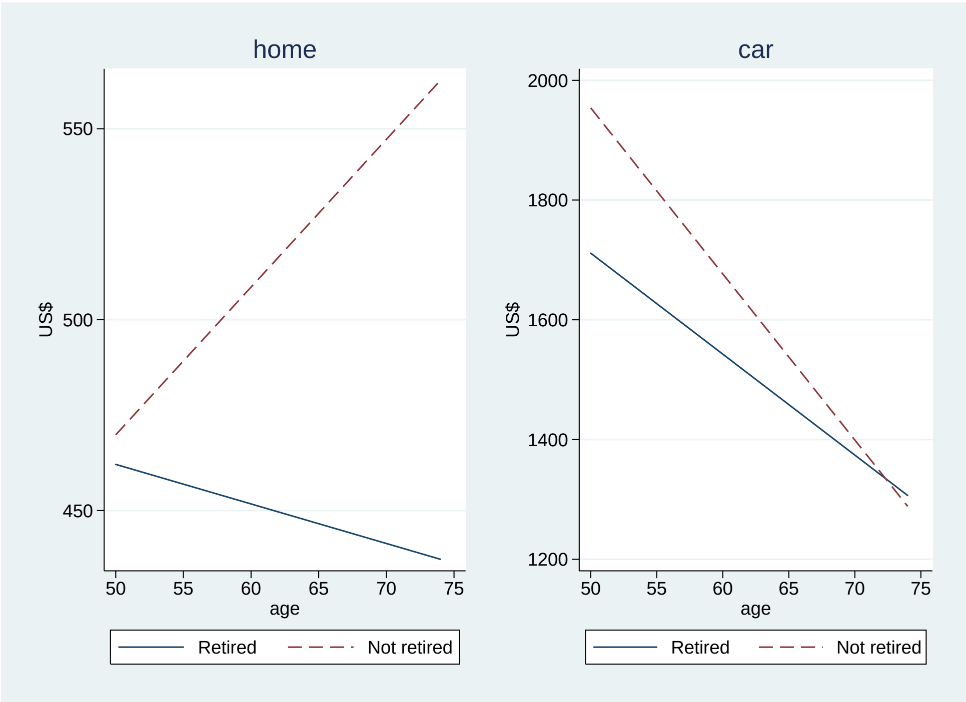

Figure A2: Expenditure on home and garden supplies and car use

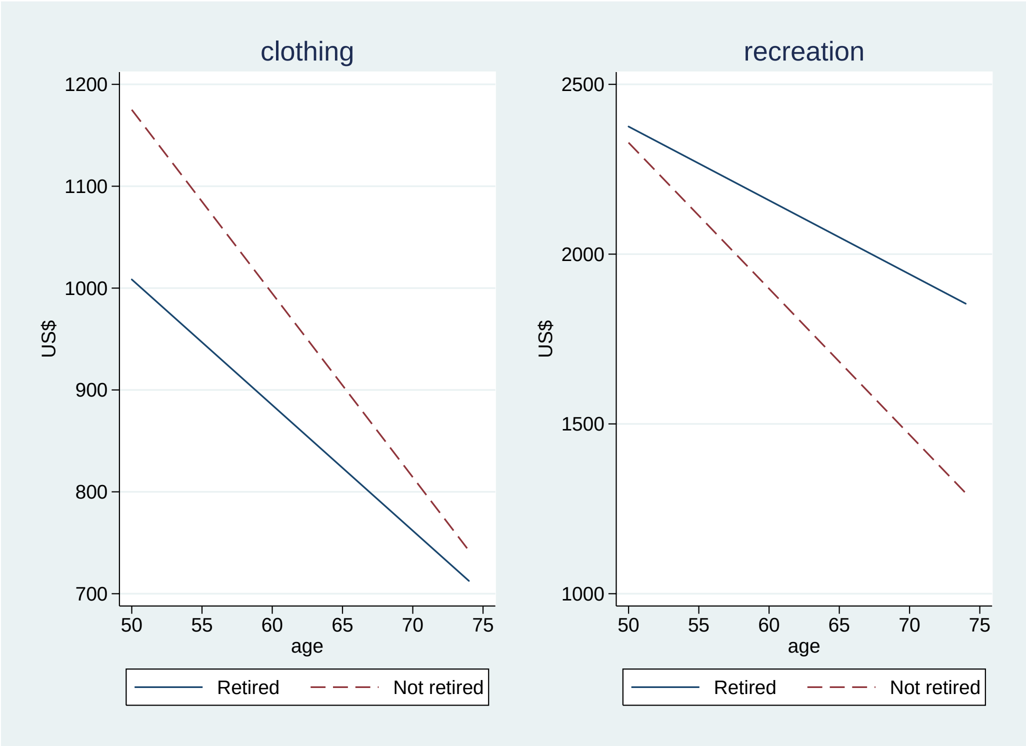

Figure A3: Expenditure on clothing and recreation

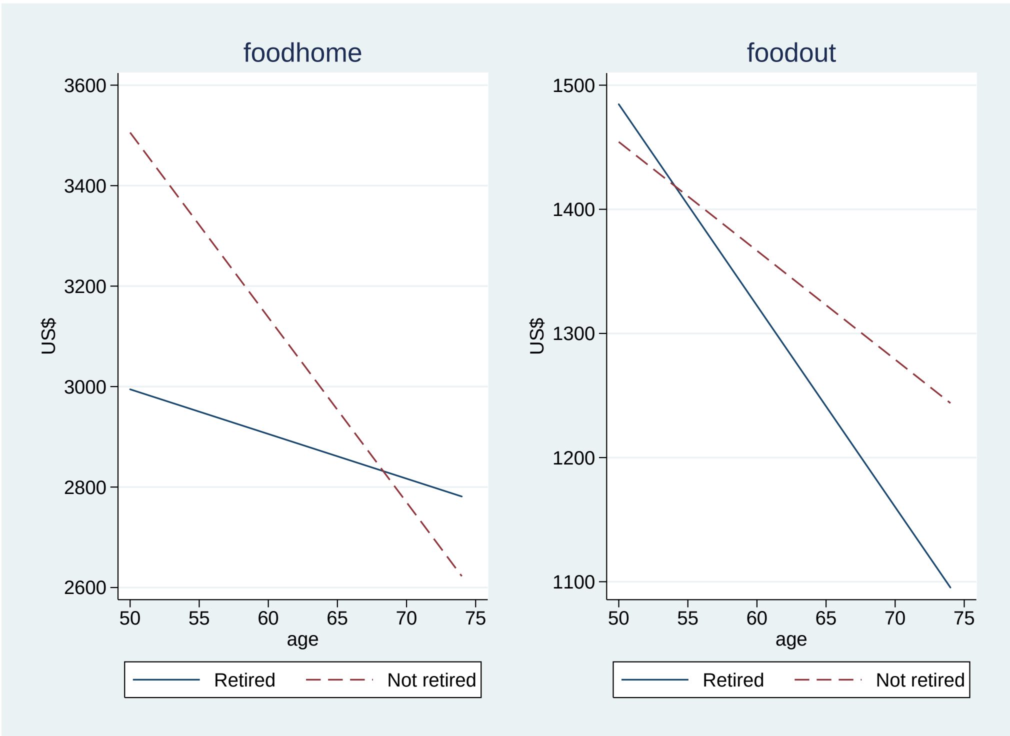

Figure A4: Expenditure on food at home and food out

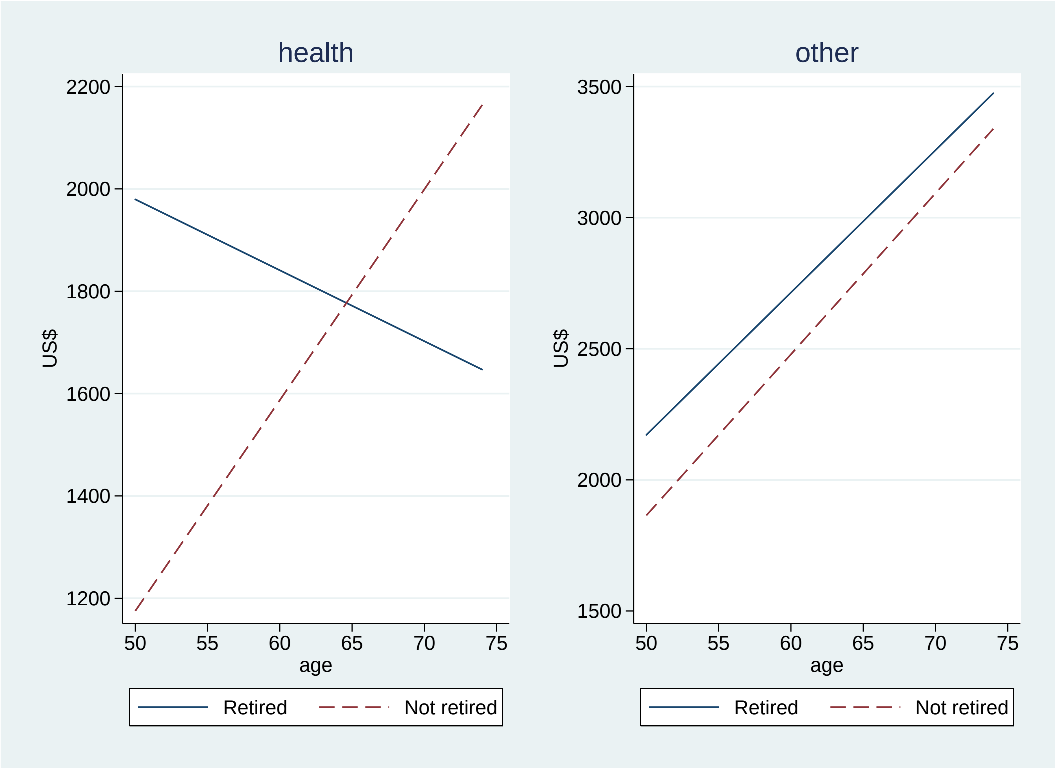

Figure A5: Expenditure on health and other expenditure

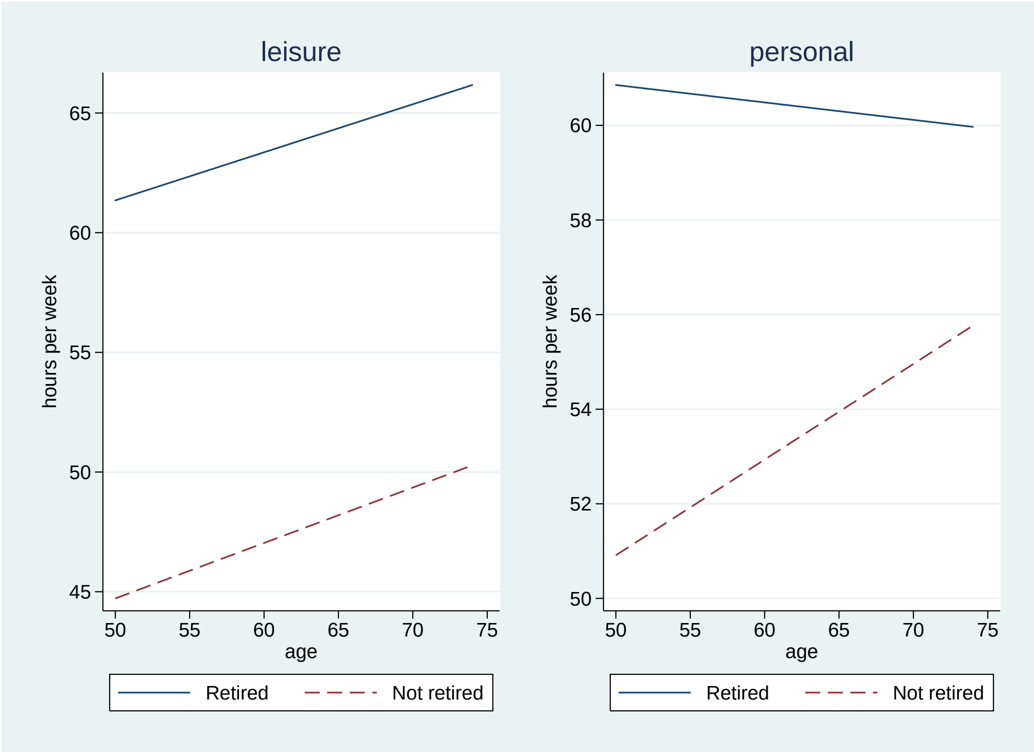

Figure A6: Time use in leisure and personal time (sleep+hygiene etc.)

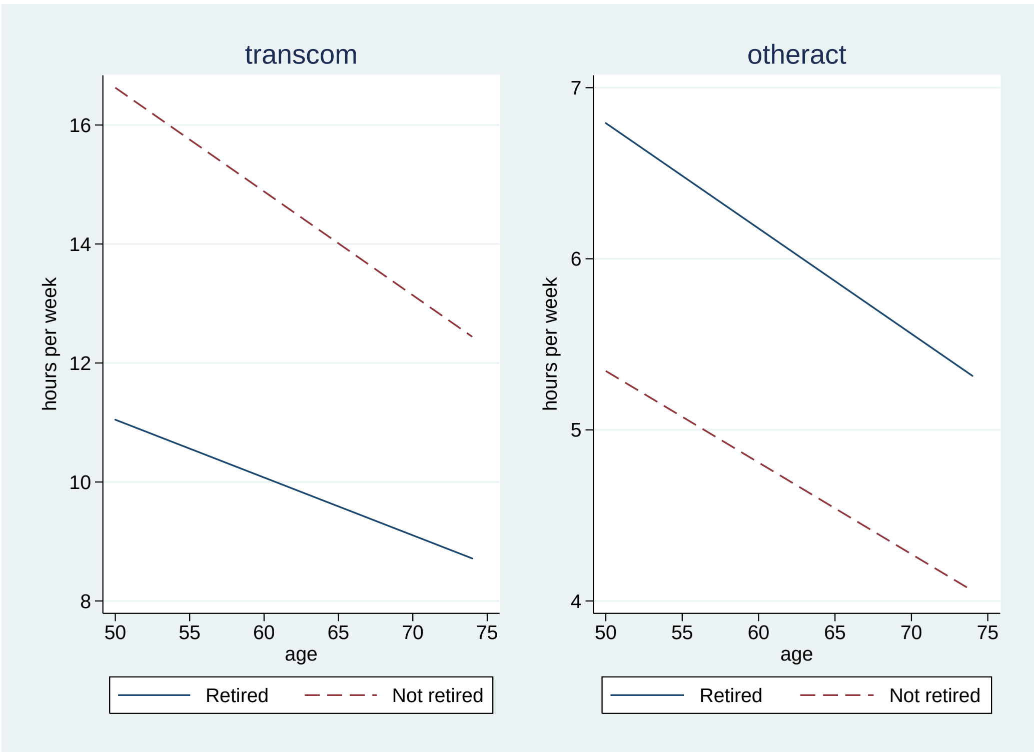

Figure A7: Time use in transport+communication and other activities

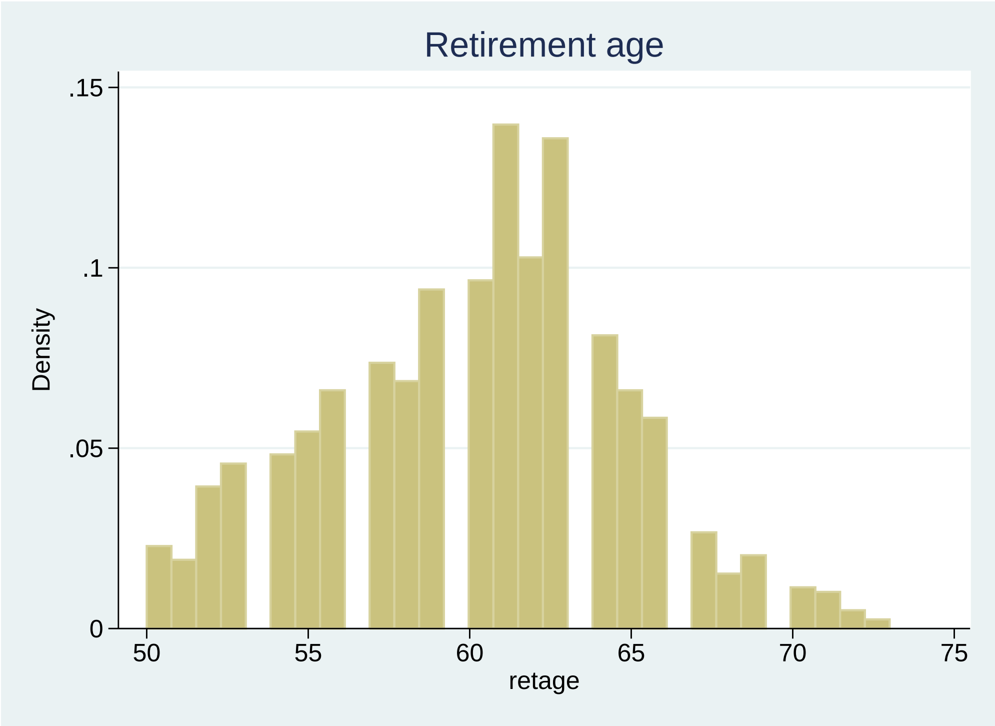

Figure A8: Retirement age, pooled sample

Figure A9: Retirement age, panel

Variable	Mean	Std.	Minimum	Maximum
Basic consumption	5124.5	3139.7	1000.0	31324.8
Food at home	2960.8	1613.2	0.0	9975.5
Housework	21.8	13.4	0.0	93.4
Age	63.8	6.0	50.0	75.0
Woman	0.6	0.5	0.0	1.0
Partner	0.7	0.5	0.0	1.0
Number of children	3.4	1.9	0.0	18.0
No. of residents in household	2.1	1.0	1.0	8.0
Education in years	13.0	2.7	0.0	17.0
Household income, US$	57747.0	65632.4	0.0	744346.1

Table A1: Summary statistics for dataset

	Var. name in panel	Var. name in CAMS 2001	Var. name in CAMS 2003
Mortgage	XB7	B7	B13
Home/rent insurance	XB8	B8	B7
Property tax	XB9	B9	B8
Rent	XB10	B10	B14
Electricity	XB11	B11	B15
Water	XB12	B12	B16
Heat	XB13	B13	B17
Phone/cable	XB14	B14	B18
Auto finance charges	XB15	B15	B19
Auto insurance	XB16	B16	B9
Health insurance	XB17	B17	B11
House/yard supplies	XB18	B18	B20, B22
Home maintenance	XB19	B19	B24, B25
Food/drink groceries	XB20	B20	B36
Dining out	XB21	B21	B37
Clothing	XB22	B22	B26
Gasoline	XB23	B23	B38
Vehicle service	XB24	B24	B10
Drugs	XB25	B25	B28
Health services	XB26	B26	B29
Medical supplies	XB27	B27	B30
Vacations	XB28	B28	B12
Tickets to movies, sports events etc.	XB29	B29	B31
Hobbies/leisure equipment	XB30	B30	B32, B33
Contributions	XB31	B31	B34
Gifts	XB32	B32	B35

Table A2: List of consumption groups in CAMS consumption survey

Code	Description	Observed	Activity type*
A1	WATCH TV	weekly	L
A2	READ PAPERS/MAGS	weekly	L
A3	READ BOOKS	weekly	L
A4	LISTEN MUSIC	weekly	L
A5	SLEEP/NAP	weekly	P
A6	WALK	weekly	T
A7	SPORTS/EXERCISE	weekly	L
A8	VISIT IN PERSON	weekly	L
A9	PHONE/LETTERS/EMAIL	weekly	L
A10	WORK FOR PAY	weekly	M
A11	USE COMPUTER	weekly	T
A12	PRAY/MEDITATE	weekly	L
A13	HOUSE CLEANING	weekly	H
A14	WASH/IRON/MEND	weekly	H
A15	YARD WORK/GARDEN	weekly	H
A16	SHOP/RUN ERRANDS	weekly	H
A17	MEALS PREP/CLEAN-UP	weekly	H
A18	PERSONAL GROOMING	weekly	P
A19	PET CARE	weekly	L
A20	SHOW AFFECTION	weekly	O
A21	HELP OTHERS	monthly	O
A22	VOLUNTEER WORK	monthly	O
A23	RELIGIOUS ATTENDANCE	monthly	L
A24	ATTEND MEETINGS	monthly	T
A25	MONEY MANAGEMENT	monthly	H
A26	SELF CARE	monthly	P
A27	PLAY CARDS/GAMES/PUZZLES	monthly	L
A28	CONCERTS/MOVIES/LECTURES	monthly	L
A29	SING/PLAY MUSIC	monthly	L
A30	ARTS AND CRAFTS	monthly	L
A31	HOME IMPROVEMENTS	monthly	H

*) H: Housework, L: Leisure, M: Marketwork, P: Personal care including sleep,
T: Transport and communication (computer time), O: Other activities.

Table A3: List of activities in CAMS time use survey

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